RAISING CANE

ARS RESEARCH BENEFITS SUGARCANE GROWERS AND PROCESSORS

Louisiana—home of the brown pelican, Cajun cuisine, New Orleans jazz, and Tiger football—is also home to nearly 500,000 acres of sugarcane. The state is the second-largest producer of sugar from cane in the United States, with the industry contributing $500 to $600 million to Louisiana's annual economy.

There are currently 15 factories in Louisiana that turn cane into sugar. Now, several of them are benefiting from a more effective processing technology, thanks to work done by a scientist with the Agricultural Research Service in cooperation with the American Sugar Cane League (ASCL). The ASCL is a trade association representing Louisiana sugarcane growers and raw sugarcane processors. The scientist's work is, in fact, the culmination of a statewide agricultural revolution that began with the introduction of a new crop variety and also encompassed a change in harvesting technique.

The Switch From Soldier to Combine

From 1943 through 1995, soldier—or whole-stalk—harvesting of sugarcane was the predominant method used in Louisiana. Soldier harvesters travel along sugarcane rows and gather the stalks in their upright positions. They cut the stalks at their base, remove their sugarless tops, and drop the stalks across two adjacent rows, forming what is called a heap row. The harvester got its name from the way the stalks seem to march through the machine while they're being collected. Piles of harvested cane are collected and trucked to a nearby factory for processing.

Although soldier harvesting was the accepted method for more than five decades, during the past 8 years many Louisiana

PEGGY GREB (K10662-1)

In the factory yard at the Cora-Texas Manufacturing Company, White Castle, Louisiana, chemist Gillian Eggleston (red jacket) and production manager Adrian Monge discuss hot liming, a process for clarifying sugarcane juices. INSET: Eggleston and Monge inspect billeted cane and associated trash.

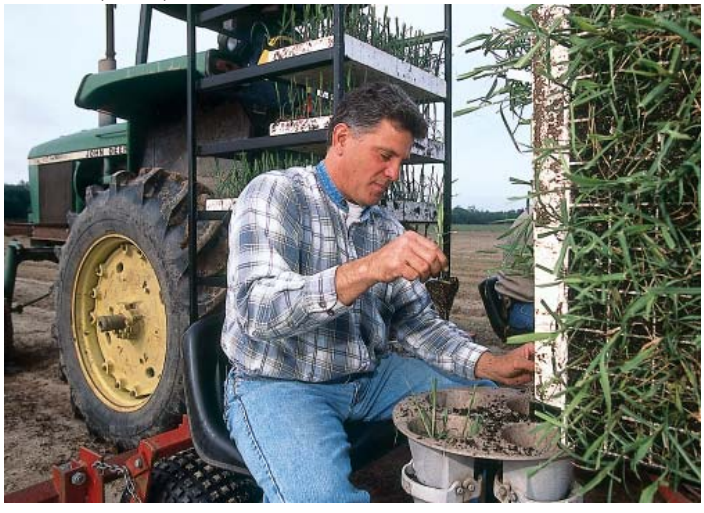
PEGGY GREB (K10661-1)

Adrian Monge inspects clarified juices extracted from sugarcane stalks.

Louisiana Sugarcane
Looking for That "One in a Million"

PEGGY GREB (K10663-1)

PEGGY GREB (K10668-1)



Technician David Verdun transplants sugarcane seedlings to the field. He supervises and assists in the annual transplanting of about 125,000 seedlings. About one-third are wild derivative genotypes originating from crosses performed at Houma, Louisiana; two-thirds are commercial types largely from the ARS research station at Canal Point, Florida.

Sugarcane was introduced into southern Louisiana by the Jesuits in 1751. But during the early years of the 20th century, root rot and mosaic virus nearly destroyed the crop and the industry it supported.

In 1924, the U.S. Department of Agriculture established a research station at Houma, Louisiana.

Two years later, it entered into a three-way memorandum of understanding with the Louisiana State University (LSU) Agricultural Center at St. Gabriel and the American Sugar Cane League (ASCL) to test new sugarcane varieties.

Over the next few years, the station—and its cooperators—helped save the state's sugarcane industry through introductions of disease-resistant and disease-tolerant varieties from abroad. The three partners have continued their varietal improvement work to this day.

Since southern Louisiana's winter temperatures are not conducive to the flowering of cane and the production of true seed, or "fuzz," ARS' commercial sugarcane efforts take place at its Sugarcane Field Station at Canal Point, Florida. The seed produced there is then shipped to Houma for planting and evaluation. Cooperators at LSU's Agricultural Center also produce seed, but in indoor facilities. At Houma, scientists use indoor facilities to make crosses with wild species to create experimental breeding lines for researchers at the two other locations, with hopes of introducing useful new traits, such as pest resistance, for future commercial varieties.

Ed Richard, who leads ARS' Sugarcane Research Unit at Houma, says, "We plant 130,000 potential varieties annually, and LSU AgCenter plants another 100,000. It'll take 12 to 14 years to identify and develop a new superior variety from these.

"Right now," he continues, "we have two varieties that are candidates for release in 2003—Ho 95-988 and HoCP 96-540. They rival the production capacity of LCP 85-384."

That's good news to Robert Judice, a farmer who's been growing sugarcane in Louisiana since 1962. "This year, 95 percent of my fields are planted with 384. Next year, it'll be closer to 100 percent because it yields so well. But planting all one variety scares me. I'd like a little more diversity, just in case a new disease or pest begins attacking 384," he says.

Thanks to the work being done at Houma, St. Gabriel, and Canal Point, he should get that diversity soon.—By **Amy Spillman,** formerly with ARS.

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producers have shifted to combine—or chopper—harvesting. According to Ben Legendre, former research leader of ARS' Sugarcane Research Unit at Houma, Louisiana, and current sugarcane specialist with the Louisiana State University Agricultural Center (LSU AgCenter) at St. Gabriel, the shift corresponds with the introduction and expanded planting of a new, higher yielding crop variety known as LCP 85-384.

The product of a breeding program run cooperatively between ARS, the LSU AgCenter, and ASCL, LCP 85-384 produces about 30 percent more sugar per acre than the varieties it replaced. Says Windell Jackson, ASCL's senior agronomist, "I've been working with Louisiana growers for 30 years, and normally it takes at least 5 years before a new variety takes up any kind of significant acreage. But [variety] 384 is high-yielding and continues to produce an economic yield of sugarcane for three to four annual harvests, so it took off real, real fast."

Cane grower Robert Judice concurs. "Sugarcane doesn't get planted annually. You harvest from the same plant for a few years, although yields decrease every year. With 384, we took in almost as much cane the second year as we did the first. Planting it was a good investment."

Its only drawback? Its stalks are predisposed to lie down, or lodge, late in the season, especially after a thunderstorm or tropical system that brings high winds and rainfall.

PEGGY GREB (K10664-1)

Billeted sugarcane with trash (top) and cleaned of trash (bottom).

Soldier harvesters aren't very good at picking up lodged cane. But combine harvesters are. They scoop up the fallen cane stalks, cut them into sections called billets as they pass through the machine, and drop the billets into a wagon traveling alongside for eventual transport to the factory for processing.

By 1995, LCP 85-384 had started to show sugarcane growers how well it could produce. That same year, Hurricane Opal blew through southern Louisiana and knocked down many of the varieties that were supposed to stay erect. Ed Richard, current leader of ARS' Sugarcane Research Unit in Houma, says, "The combine harvester was introduced in this area around the same time as 384. It was a good marriage, and in 1995, we saw how well the chopper worked at picking up lodged cane."

The machine worked so well that many growers bought their own during the next few years. Only one combine harvester was operating in Louisiana in 1995, but by 2002, the number had jumped to 400. In 2002, close to 80 percent of the state's sugarcane acreage was planted with LCP 85-384, after being introduced just 9 years earlier.

Processing the Cane: Hot vs. Cold Liming

Changes in the Louisiana sugarcane industry didn't end with the introduction of LCP 85-384 and combine harvesters. Another change is now occurring at processing plants throughout the state, thanks in large part to Gillian Eggleston, a chemist and lead scientist with the Commodity Utilization Research Unit at ARS' Southern Regional Research Center in New Orleans. Since 1995, she has been working with industry to figure out the best way to clarify sugarcane juice.

After sugarcane has been harvested, it's trucked to a mill or factory where it's generally washed and shredded, then pressed between rollers so the juice containing sugar can be extracted. Once the raw juice has been drawn from the cane, it's clarified to remove impurities. The degree of clarification affects sugar yield and the refining quality of raw sugar.

Richard estimates that combine systems are able to harvest 90 to 95 percent of lodged sugarcane in a field. This is much better than the 75 percent soldier harvesters deliver. Unfortunately, the billeted cane brings more trash impurities (leaves and tops) and mud into the factory, which makes it more difficult to clarify.

The traditional clarification process is called cold liming. Eggleston explains how it works: "The cane juice is mixed in a tank, then lime in the form of calcium oxide is added to the tank and mixed. The solution stays at the same 'cold' temperature the entire time—about 105˚F. The lime neutralizes unwanted organic acids and forms an insoluble complex with phosphates. The complex precipitates out of solution, bringing unwanted impurities with it, and is eventually filtered off."

In 1995, Eggleston began conducting factory studies comparing cold liming with two other clarification processes—hot liming and intermediate liming. She had discussed the idea with Duane Legendre, chief engineer with Lafourche Sugars Corp., in Thibodaux, Louisiana, who also sits on the Dedicated Research Funding Committee of the ASCL. Says Legendre, "My family's factory had always used hot liming, but the place I was working at in 1995 used cold liming. I wanted to know which clarification process was better."

In hot liming, the cane juice is preheated to 180˚F to 200˚F. It is then heated quickly, under pressure, to 220-225˚F. When the pressure is released, the juice begins to boil violently, or flash, and the lime is added. In some factories, the lime can be added just before the flashing stage. In intermediate liming, only 30-50 percent of the juice is preheated. The lime is added when all the juice is about 150˚F, and then it's flash-heated to 220˚F.

Eggleston knew that other areas of the world had switched from cold liming to mostly hot liming, but in 1995, cold liming was still the preferred processing method in the United States. "The main advantages were considered to be its simplicity of operation and the lower levels of sucrose inversion, or sucrose losses, it generated," she says.

"But these conclusions were drawn mainly from laboratory studies, which don't always take into account the complexities of factory processing." Eggleston decided to take her research to the factories themselves and was helped with grants from the ASCL.

PEGGY GREB (K10671-1)

Agronomist Ed Richard, Jr. (right), and geneticist Thomas Tew inspect sugarcane seedlings transplanted to the field in early April. Seedlings will be cut back in late fall, but actual selection won't occur until September of the following year.

Big Benefits From Hot Liming

From 1995 through 2000, Eggleston worked with factory operators and engineers to gather data and compare the three clarification processes. During the last few years, she cooperated with Adrian Monge, the production manager for Cora-Texas Manufacturing Company in White Castle, Louisiana.

"Gillian came to the factory and talked to us about her research," Monge says. "We had already been investigating intermediate liming, but not hot liming. We decided to put in a hand to help, and we collected data with her. The research made a difference, and we ended up switching to hot liming. The results we got proved that the change was worth it."

Eggleston explains some of the benefits of hot liming: "By switching from cold to hot liming, a medium-size factory like Cora-Texas could reduce its sucrose losses enough to save $283,000 per season. That's a conservative estimate," she adds.

By making the switch, the same factory could also reduce its lime consumption by at least 20 percent. And, it would need 90 percent fewer chemicals to clean its heat exchangers.

Depending on the equipment they're using, factory managers might spend anywhere from several hundred to several thousand dollars to change from cold or intermediate to hot liming. "But," says Eggleston, "the economic advantages of operating hot liming across a sugarcane processing season more than make up for this investment in just 1 year."

Roddy Hulett, chairman of ASCL's Dedicated Research Funding Committee, has seen factorys take Eggleston's research to heart. "Our organization funds research like Gillian's," he says, "but we let the mills decide how to use the results."

The response has been overwhelming. Hulett says, "In 1995, only one factory in the state was using hot liming. As of late 2002, five factories were using it, and another one had made the switch in Florida. A sixth processor in Louisiana has committed to making the switch during the 2003 grinding season, and I expect we'll see even more factories go to hot liming next year.

"Gillian's work," he sums up, "shows the many economic and processing advantages gained by changing to hot liming, particularly now that growers harvest mostly billeted cane."

One of the manuscripts Eggleston wrote about her research won the American Society of Sugarcane Technologists' Outstanding Paper Award (Manufacturing Section) in June 2000.—By **Amy Spillman,** formerly with ARS.

This research is part of Quality and Utilization of Agricultural Products, an ARS National Program (#306) described on the World Wide Web at www.nps.ars.usda.gov.

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